The National Academies of
SCIENCES · ENGINEERING · MEDICINE

TRANSPORTATION RESEARCH BOARD

Development and Management of Sustainable Information Portals

Wednesday, May 2, 2018
1:00-2:30 PM ET

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.

RCEP

REGISTERED CONTINUING EDUCATION PROGRAM

Purpose

Discuss NCHRP Report 865.

Learning Objectives

At the end of this webinar, you will be able to:

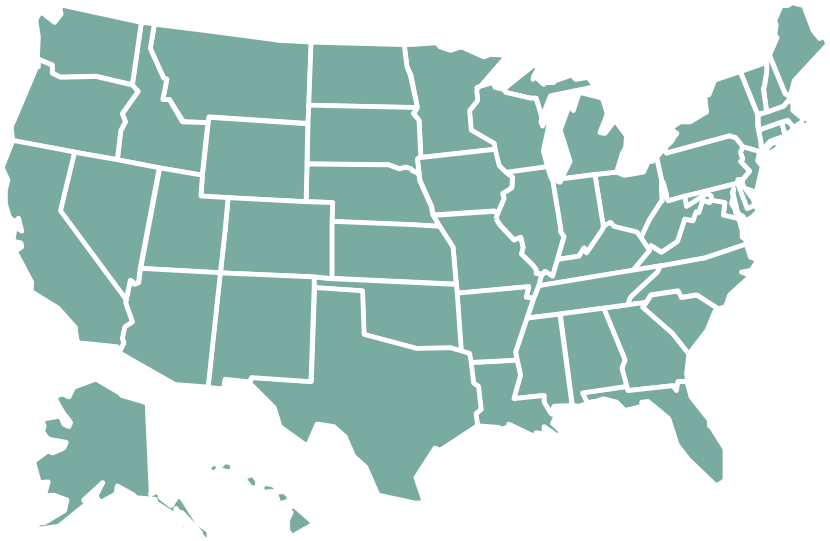
- Define EIP and describe EIP examples
- Understand how to design a sustainable EIP
- List the technologies used in successful EIPs
- Describe the non-technical challenges to implementing an EIP

NCHRP Research Report 865: Guidance for Development and Management of Sustainable Enterprise Information Portals

NCHRP Project 20-103

NCHRP is a State-Driven Program

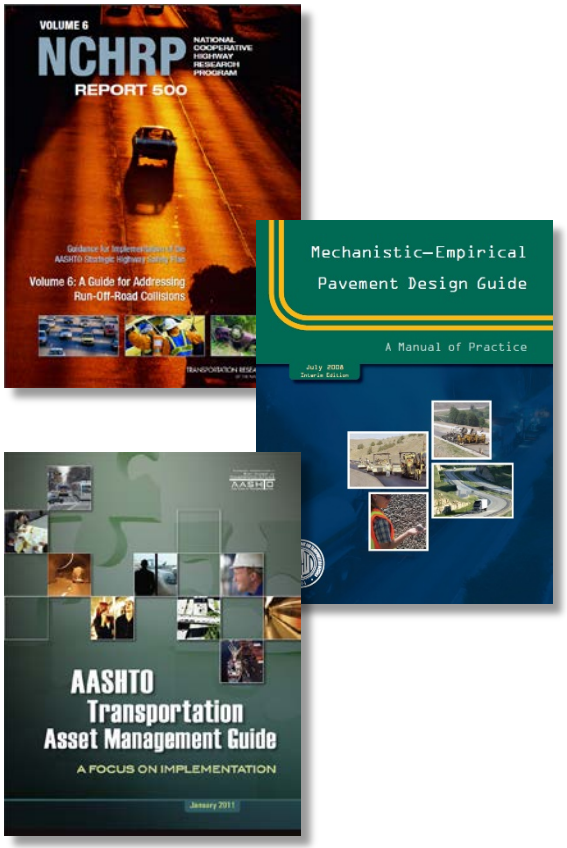
- Sponsored by individual state DOTs who
  - Suggest research of national interest
  - Serve on oversight panels that guide the research.



- Administered by TRB in cooperation with the Federal Highway Administration.

Practical, ready-to-use results

- Applied research aimed at state DOT practitioners
- Often become AASHTO standards, specifications, guides, syntheses
- Can be applied in planning, design, construction, operations, maintenance, safety, environment



Additional NCHRP Publications Available on this Topic

- NCHRP Synthesis 508: Data Management and Governance Practices

You can learn more about this publication by visiting www.trb.org

Join us for a TRB Webinar

Resiliency in Practice: Strategies for Knowledge, Information, and Data

May 30, 2018 from 2:00-3:30pm EST

Learn more at:

http://www.trb.org/Calendar/Blurbs/177504.aspx

Today's Speakers

- Benjamin Pecheux, *AEM Corporation – Main Presenter*
- *Marc Hoit, North Carolina State University*
- *Sheryl Miller, toXcel, LLC*
- *Loren Turner, California DOT*
- *Michelle Morgan, Washington State DOT – Moderator*

MAY 3, 2018

Development and Management of Sustainable Information Portals

Guidance for Transportation Agencies

Briefing Organization

- What is an Enterprise Information Portal (EIP)?
- Achieving Sustainable EIPs using Microservice Architecture Pattern
- Designing for Sustainable EIPs
- Technology Recommendations for EIPs
- Microservice Creation & Organization – Asset Management Example
- Migration Strategy from Monolith to Microservice Architecture
- Overcoming Non-Technical EIP Implementation Challenges

Enterprise Information Portals for Departments of Transportation

What is an Enterprise Information Portal (EIP)?

*An **EIP**, also known as a business portal, is a 'web site' that serves as a single gateway to a company's information and knowledge base for employees, customers, business partners, and the general public.*

- EIPs integrate management information systems, decision support systems, enterprise information systems, and other technologies.
- EIPs are tailored or personalized to the intended user or groups of users.
- EIPs provides access to a broad range of resources and services through a variety of interfaces.

Common Services Offered by DOT EIPs

- Asset Management, Engineering and Maintenance Services
- GIS and Mapping Services
- Operations & Performance Management Services
- Documents and Library Services
- Bid and Contract Services
- IT Services
- Environmental Services
- Public Outreach Services
- Photo and Video Services
- Financial Services

How are Departments of Transportation Implementing EIPs?

- DOTs typically have multiple portal platforms with multiple services, some of which are integrated, while others are stand-alone
- Internal DOT portals are typically more integrated than externally facing portal
- The technology and architecture of portals varies by organization size, budget, and expertise as well as State requirements pertaining to the management of data

What is Sustainability in the Context of EIPs

Sustainability *is the ability of the enterprise to meet its present needs without compromising its ability to meet future needs*

It's not just about continuity of funding, making EIPs sustainable requires focus on:

- **Technologies,**
- **Policies,**
- **Procedures, and**
- **Governance.**

The cornerstones for sustainability are *replaceability* and *resiliency of services and systems within the EIP*

Trends in Moving toward Sustainable EIPs

*A **service-oriented architecture (SOA)** is not just an architecture of services from a technology perspective; they are the policies, practices, and frameworks by which we ensure the right services are provided and consumed. The basic principles of SOA include independence of vendors, products and technologies.*

- ✓ Moving away from a monolithic and heavily integrated portal applications to a modular, ***service-oriented architecture***
- ✓ Less in-house hardware and data storage, and more distributed hardware and data storage leveraging cloud services
- ✓ More distributed software portal applications
- ✓ Less integrated management of individual portal application, more autonomy for applications

Why a Mix of On Premise & Cloud IT Infrastructure?

Why On Premise

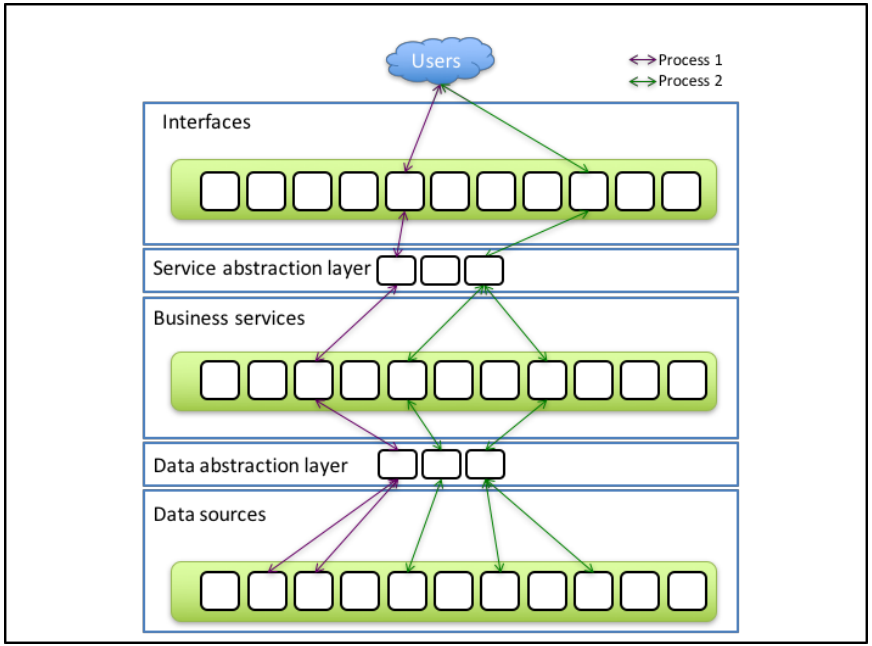
- To meet government regulations for storing sensitive data
- Need for unique/advanced security beyond cloud offerings
- Visibility of data ‘residency’
- Bandwidth constraining accessibility at the last mile
- More direct control over latency

Why Cloud

- Shifts the risk of IT infrastructure obsolescence to the Cloud provider
- Enables a scalable, flexible and on demand set of IT capabilities
- Reduces IT infrastructure operation and maintenance time
- Lower cost profile

What is a Distributed Software Architecture?

*A **distributed system** is one in which the computing power and software is distributed across several servers, connected through a network, communicating and coordinating their actions by passing messages to each other.*

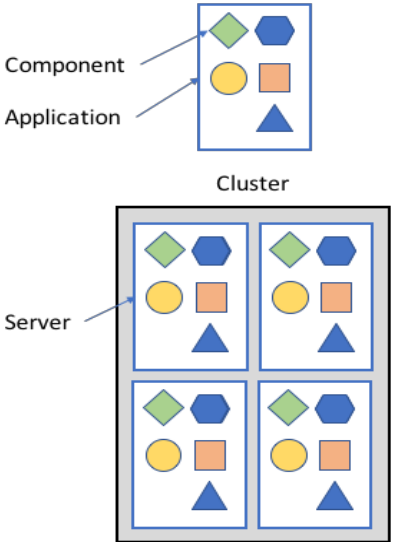


Achieving Sustainable EIPs

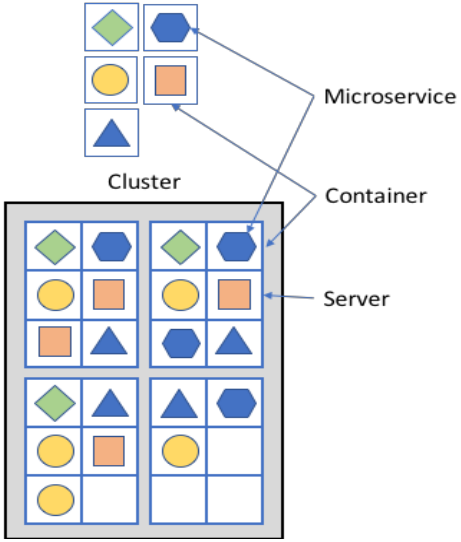
Brief Introduction to Microservice Architecture Pattern

What is a Microservices Architecture?

Traditional Monolithic Architecture Pattern



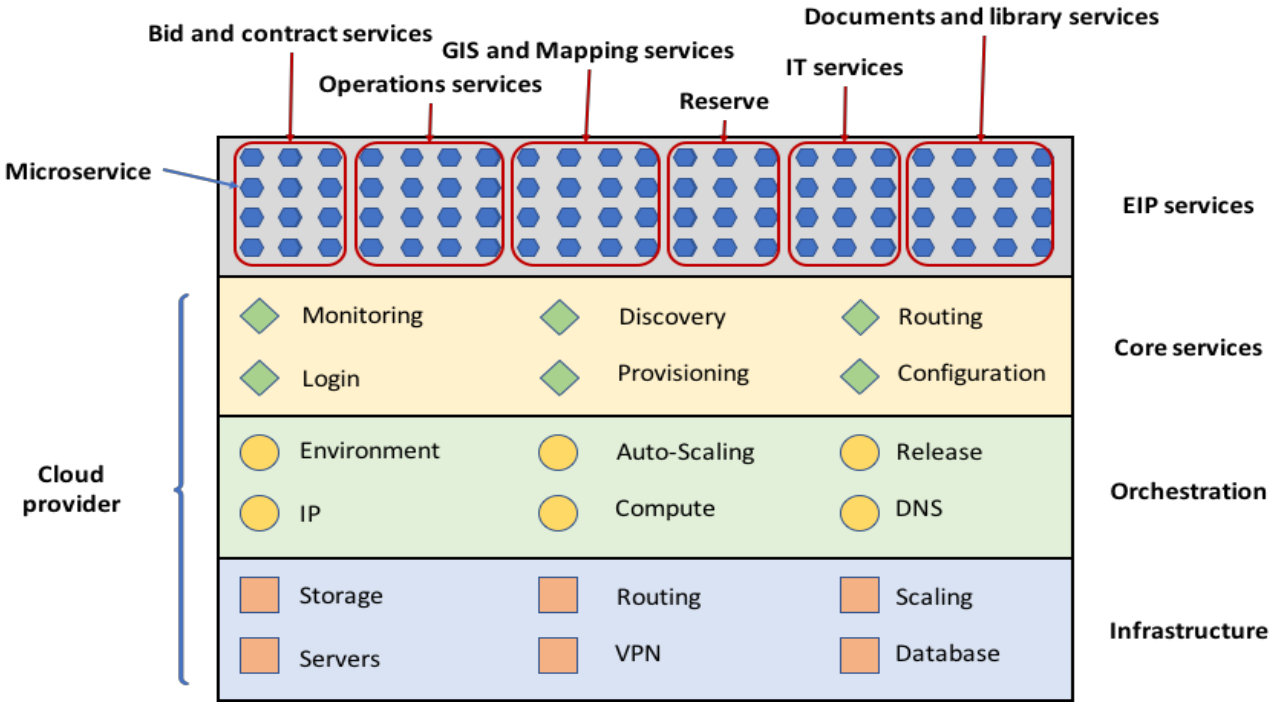
Microservice Architecture Pattern



Modular Space System Analogy

Rather than using large, complex, single satellite, agencies are migrating to a suite of connected, independent, low-cost, and replaceable small satellites, each with its own function (e.g. communication, imagery, sensors). This decomposition and migration to autonomous modules offers these agencies ease of functionality, ease of replaceability, and ease of modernization with newer modules.

Microservice Implementation Example of a DOT EIP on Cloud Infrastructure

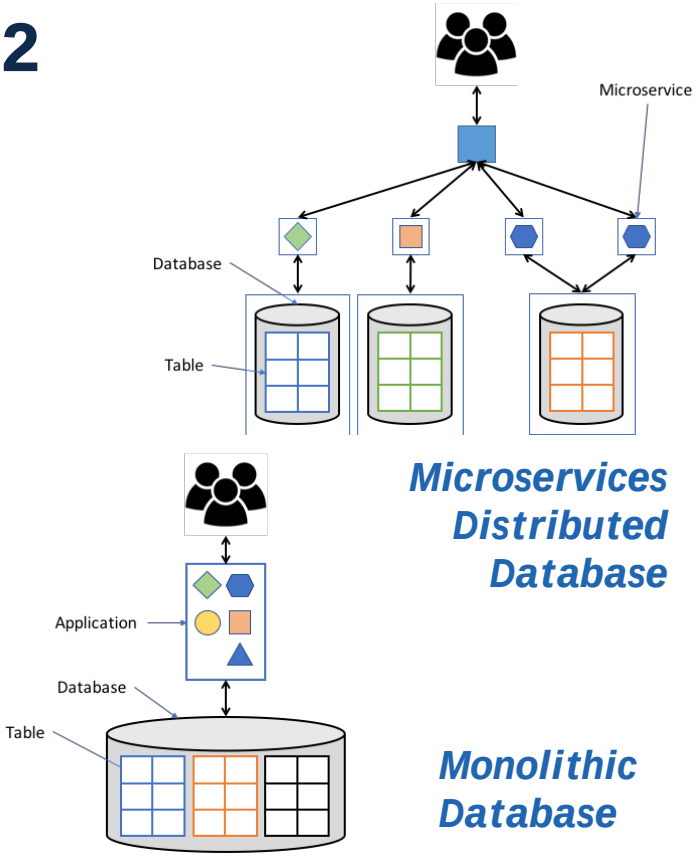


- **Auto-scaling** - A cloud computing service feature that automatically adds or removes computing resources based on actual demand
- **Load balancing -**The process of distributing workload evenly across computing resources in a cloud computing environment

Change in EIP Practices, part 1 of 2

When Adopting a Microservice Architecture

- Design for failure
- Single lifecycle ownership of the product
- Exercise choice in platforms, language & libraries
- Decentralized business and messaging rules
- Decentralized governance
- Decentralized data management



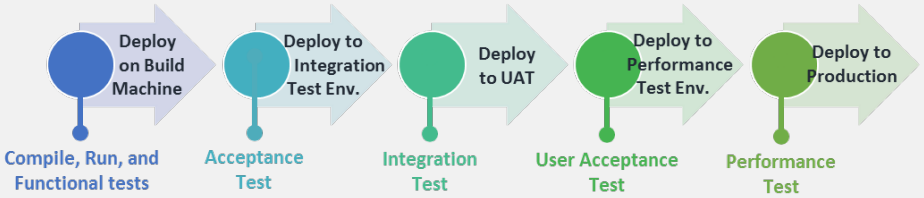
Change in EIP Practices, part 2 of 2

When Adopting a Microservice Architecture

- **Organize teams around business capabilities not technology layer**
  - **cross functional teams by business capability are a requisite**
  - **traditional technology layer based teams (e.g. a database applications teams or a user interface team) means extensive cross-team collaboration and costly delays**

- **Move beyond Continuous Integration to Continuous Delivery**
  - Maintain tight integration requirements within the microservice while easing external integration requirements
  - Continuous Delivery means development teams build software so that the software can be released to production at any time and by anyone on the team

Example of a Basic Automated Build Pipeline that Supports Continuous Integration



Designing for Sustainable EIPs

Technology Recommendations

Operating Environment Recommendations for Designing for a Sustainable EIP

- **Mixed infrastructure (cloud and on premise)** allows increased scalability and reliability of the EIP applications while allowing sensitive data to be kept in house.
- **Application deployment and server configuration** can be cloud based or by using open-source configuration management service with a containerized architecture.
- **Implementation of the EIP is recommended using**
- **Open Source continuous integration (CI) tools**
- **Hosted CI service (software as a service), or**
- **Proprietary continuous integration (CI) tool**

Technology Recommendations for Services

- **Services** - Cloud services or open source framework on cloud
- **Databases** – Combination of cloud storage and various databases / search engines
- **User Interfaces** – All web and mobile interfaces no desktop applications
- **Storage** – Mix of cloud and on-premise storage solution
- **Management** - Cloud services or open source framework on cloud
- **Security** – Cloud Identity management software and audits/evaluations

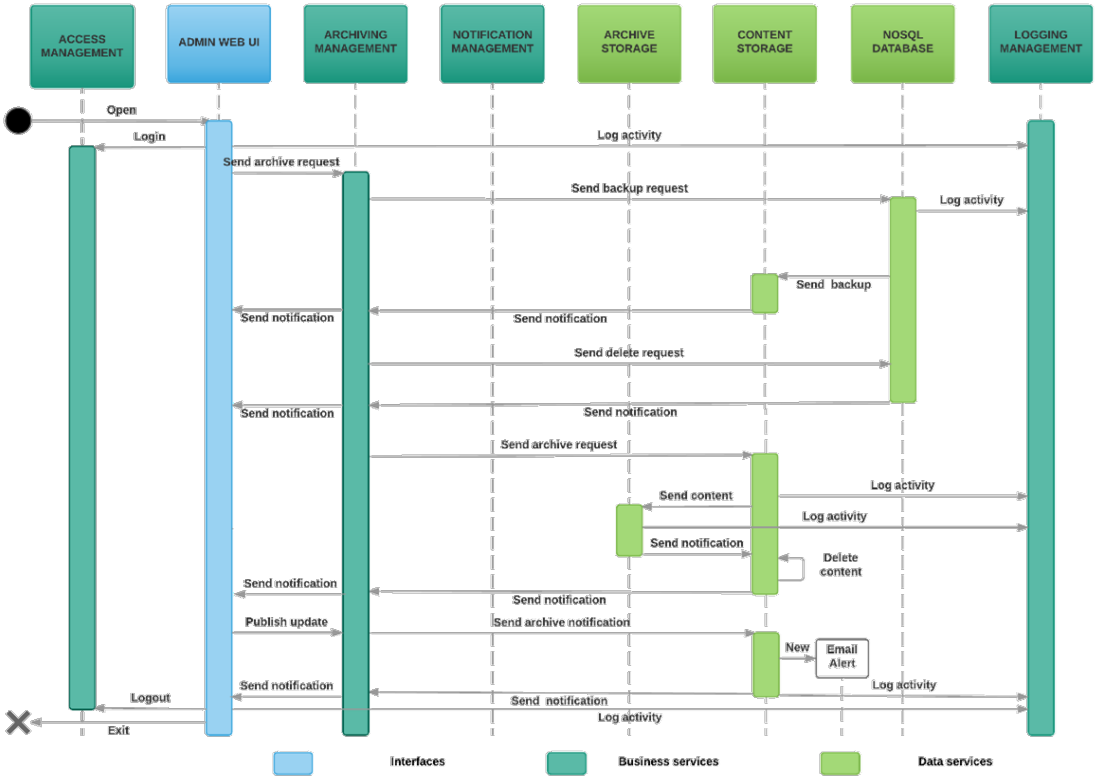
*Based on a survey of industry practitioners

Microservice Creation and Organization

Asset Management Implementation Example

Asset Management Services Sequence Diagram

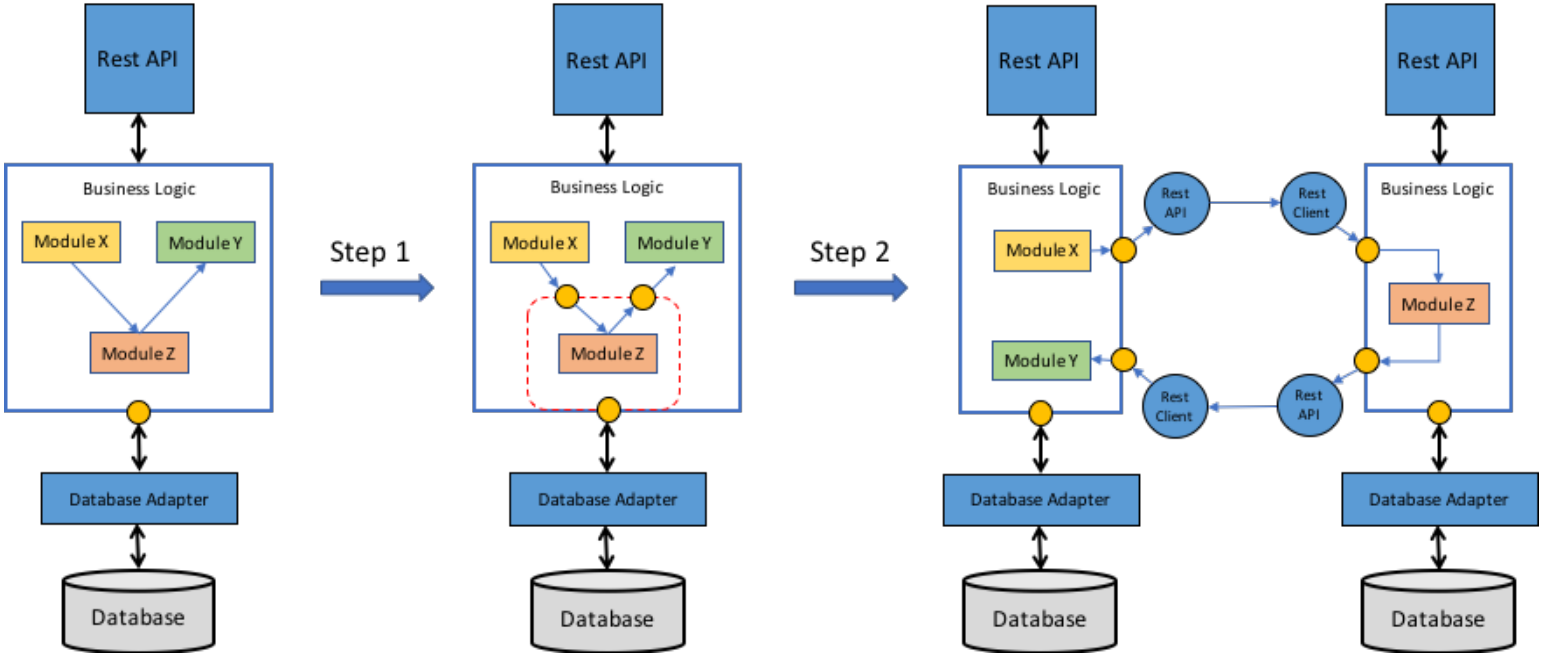
- Sequence diagrams show how objects operate with one another, and in what order, during a specific scenario.
- An important characteristic of a sequence diagram is that time passes from top to bottom
- The illustrated scenario is specifically for “DOT maintenance employee archives older asset data”



Focus on Migration Strategies

From a Monolithic to a Microservices Architecture

Migration Strategy: Use Incremental Refactoring



Microservice Success

Strategies to overcome the non-technical hurdles

Migration to Microservices is Transformational

- DOT Agencies vary considerably in their program area priorities, organizational structure, and culture with respect to IT and innovation.

Making DOT EIPs sustainable will require transformations in equipment, facilities, staff, processes, procedures, organization and culture.

Transforming DOTs

Strategy: Establish stakeholder buy-in with focused and continual outreach

- Elevate IT presence to the executive level and cultivate a sponsor/champion.
- Formulate the Business Case conveys value, risks, scope, cost, timeline, and benefits.
- Develop concise talking points for each stakeholder group that resonates with their needs.

Strategy: Establish consistent, flexible governance minimizes frustration

- Focus shifts away from managing hardware/software resources to managing user access to data, and protecting data from unauthorized access.

Transforming DOTs

Strategy: Simplify procurement

- Establish ongoing dialogue and collaboration among IT, HR, Legal, and Financial stakeholders in evolving procurement processes prior to any specific procurement.
- Establish a common understanding of IT procurement needs
- Identify procurement and purchasing issues that may require new ways of doing business
- Some DOT agencies have a separate procurement group for IT/Cloud services procurement, or a State-level IT cloud procurement entity.
- Others will have to champion changes to procurement law to address this need for IT flexibility.

Transforming DOTs

Strategy: Continually develop the workforce; people are the backbone of any industry

- What most impacts success? The quality of developers and transportation experts, and their effective collaboration and communication.
- Adopt a proactive approach to recruit, develop, and retain staff.
- Recognize the importance of recurring IT training to ensure expertise with emerging practices
- Understand outsourcing trade-offs: cost savings, nimbleness and knowledge of experienced staff.

Strategy: Address legal considerations early (e.g., data sharing, data storage/location, intellectual property, and backup format requirements)

- Data sharing is becoming a big part of DOT business
- Collaborate at the State Level to address these concerns
- The addition of “Rider Clauses” in contracts to allow other states to access and use data

Top 10 Strategies for Implementing Successful EIPs

- Continually educate DOT staff on emerging IT capabilities.
- Identify & routinely connect with stakeholders and champions.
- Always lead with the business need for IT change.
- Recognize and respond to institutional factors that need to be overcome.
- Design a persuasive message and tailor it for the stakeholder
- Define and implement changes to IT practices.
- Establish, maintain, and adhere to policies and processes
  - Governance
  - Hiring and Training
  - Procurement
- Evaluate performance and identify lessons learned
- Share successes and lessons learned with peers
- Evolve based on lessons learned and look forward to offering new, high value DOT EIP services.

Today's Participants

- Michelle Morgan, *Washington State Department of Transportation,* MorganM@wsdot.wa.gov
- Ben Pecheux, *AEM Corporation,* ben.pecheux@aemcorp.com
- Marc Hoit, *North Carolina State University,* mihoit@ncsu.edu
- Loren Turner, *California Department of Transportation,* loren.turner@dot.ca.gov
- Sheryl Miller, *ToXcel,* sheryl.miller@toxcel.com

Get Involved with TRB

- Getting involved is free!
- Join a Standing Committee (http://bit.ly/2jYRrF6)
- Become a Friend of a Committee (http://bit.ly/TRBcommittees)
  - Networking opportunities
  - May provide a path to become a Standing Committee member
- For more information: www.mytrb.org
  - Create your account
  - Update your profile

Get involved with NCHRP

- Suggest NCHRP research topics
- Volunteer to serve on NCHRP panels
- Lead pilot projects and other implementation efforts at your agency
- For more information: http://www.trb.org/nchrp/nchrp.aspx

Receiving PDH credits

- Must register as an individual to receive credits (no group credits)
- Credits will be reported two to three business days after the webinar
- You will be able to retrieve your certificate from RCEP within one week of the webinar